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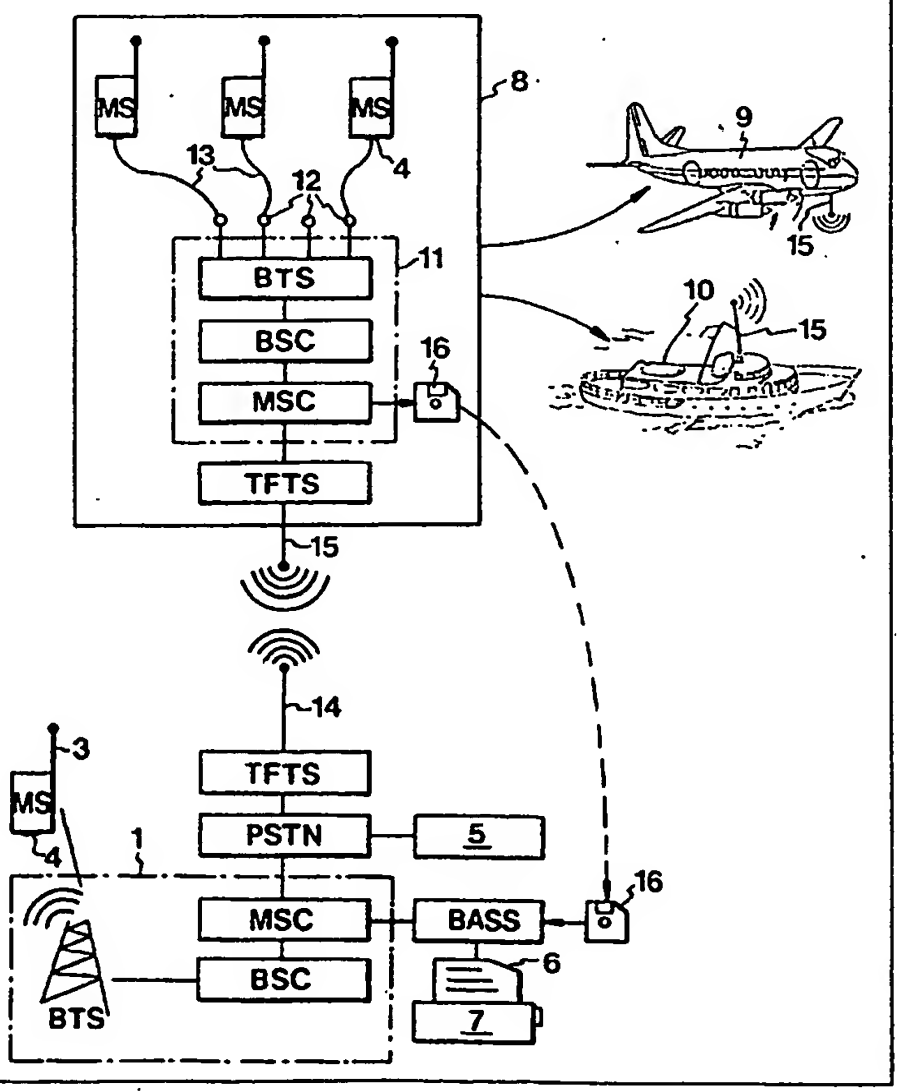
(57) Abstract

A mobile communication system (8) comprises a network (11) which has means (12) for connecting mobile stations (MS), as well as a switching means (MSC, BSC, BTS) adapted to identify the mobile stations (MS) connected to the network (11), connect calls to and from the mobile stations (MS), and record the services employed through the mobile stations (MS). The system (8) can be installed on board an aircraft (9) or a ship (10) and comprises a transmitter-receiver means (TFTS) for wireless and external signal transmission between the network (11) on board and the surrounding world. In addition, the system includes wiring (13) or IR-transmitter-receiver means for wired or wireless, internal signal transmission between the network (11) on board and the mobile stations (MS) on board connected thereto.



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MOBILE COMMUMICATIONS SYSTEM

This invention concerns a mobile communication system comprising a network which has means for connecting mobile stations, as well as a switching means adapted to identify the mobile stations connected to the network, connect calls to and from the mobile stations, and record the services employed through the mobile stations.

A common feature of all prior-art mobile communication systems of this type is that the signal transmission or the traffic between the network and a mobile station connected thereto is wireless and ensured by radio waves transmitted between the mobile station and a stationary base station forming part of the network.

In modern cellular systems, such a base station defines at least one cell, which has been assigned a frequency group that may contain one or more of the frequencies being at the disposal of the network operator. Adjoining cells are invariably assigned different frequency groups, and thus different frequencies, so that the traffic on a certain frequency between a mobile station and a base station in one cell is not to be disturbed by any traffic on the same frequency between a mobile station and a base station in another cell.

What frequencies are at the disposal of a network operator are stipulated in the government concession the operator has to hold in order to run his business. These frequencies are always carefully chosen, so that there should be no risk of the network operator colliding with any domestic rivals or with companies operating in the neighbouring countries. However, this frequency planning conducted by supranational authorities does not exclude that network operators in countries that are at a safe distance from one another in view of the ranges of transmission of the mobile and base stations are assigned the

same frequencies owing to the restricted number of frequencies available.

To enable traffic across the borders, i.e. make it possible for a subscriber to use his mobile station in foreign networks as well, some operators have opened their networks to visitors. If this is to be practicable, it does not only require frequency planning, but also the possibility of identifying the users of the network, regardless of whether they subscribe to the network currently used or to some other network.

In a prior-art mobile communication system termed GSM (Global System for Mobile Communications), this problem has been solved by providing the subscribers with special subscribers' cards, so-called smart cards or SIM (Subscriber Identity Module). These cards are of "credit-card" size or "stamp" size and contain a microchip where all the information needed for identifying the subscriber is stored (e.g. country code, operator code and subscriber's number). Such a card is insertable into different system-compatible mobile terminals, such as vehicle-mounted mobile telephones or pocket phones, which are activated when the card is inserted and thus become mobile stations that can be reached at the subscriber's unique telephone number and are open to outgoing calls as well. All information about the services employed through a mobile station is recorded by the network operator whose network has been employed and then serves as charging basis. When a subscriber uses the network of another operator, the subscriber's own operator ensures that the other operator is paid and then invoices his own subscriber in customary fashion.

Despite the fact that a mobile communication system of GSM type with its unique subscribers' cards enables trouble-free use of one's own or even a borrowed or rented mobile terminal within a fairly large geographical area by far extending beyond country borders, there remains places within this area that cannot be reached

even by a modern system of GSM type, namely on board aeroplanes and such ships as do not run close to the coast.

The reasons for this are basically the same in both cases and include problems concerning the safety on board and the range of the mobile stations. The safety problem is more prominent on board aeroplanes, while the range problem is more prominent on board ships.

On board aeroplanes, everything is done to obviate the risk of the navigation and the control system of the plane being affected by radio waves, and there is therefore a general ban on the use of private mobile stations. On board ships, the main problem facing the user is that the radio waves emitted by the mobile station are too weak to reach a base station on shore, but signal amplification, which often would be required also on board an aeroplane to enable a mobile station to reach a base station on the ground, would considerably increase the risk of the navigation and the control system being affected. Furthermore, a high signal gain might well throw the above-mentioned frequency planning into disorder and thus give rise to conflicts between different network operators as well as between a network operator from one country and the concessionary authority of another country.

In order to enable some sort of communication between e.g. telephones on board an aeroplane or a ship and telephones on the ground or on shore, the above problems notwithstanding, pay phones have been installed on some aeroplanes and ships so that the passengers are able to make outgoing calls at least. Owing to a suitable choice of frequency, transmission output power and directivity of the radio communication required between the aeroplane or the ship and a ground-based aerial station, there is no risk of any of the above-mentioned kinds of interference, despite the fact that the range by far exceeds that of, say, an ordinary mobile telephone. Thus,

the range of a project termed TFTS (Terrestrial Flight Telephony System) which, like GSM, was a European project at the outset and concerns a system especially intended for telecommunication with aeroplanes, is fully 400 km.

According to the protocol on which TFTS is based, it is possible to make four simultaneous calls per frequency between a ground station forming part of the system and connected to a public telecommunications network, and an aeroplane in communication with the ground station. A number of telephones may thus be installed on board the aeroplane (one has had pay phones in mind, since it is most expedient if each call is paid for directly) and placed at the passengers' disposal.

It will be appreciated that neither the solution with direct payment for the telecommunication services used, nor the solution with pay phones installed in the vicinity of e.g. a galley, is especially practical for the passenger who has to make a longish call, perhaps while taking notes, or has to be available to incoming calls. For such a passenger, the best solution would undoubtedly be to have a personal telephone that could be used in his own seat on board the plane, especially if the telephone could also be connected to a portable computer or a fax machine.

In view hereof, the object of the invention is to provide a mobile communication system enabling mobile stations intended for use on the ground to be employed also on board aircraft or ships at a great distance from ground-based base stations, without there being any risk of interfering with either the navigation or the control system of the craft or the above-mentioned frequency planning.

According to the invention, this object is attained by a mobile communication system which is of the type stated by way of introduction and which is characterised in that it is installed on board an aircraft or a ship, that it comprises a transmitter-receiver means adapted

for wireless and external signal transmission between the network on board and the surrounding world, and that it comprises wiring or IR-transmitter-receiver means for wired or wireless, internal signal transmission between the network on board and the mobile stations on board connected thereto.

By installing a complete network on board, which communicates with the surrounding world only via a separate transmitter-receiver means, which then may operate on suitable frequencies separate from those reserved for the mobile stations, and by connecting the mobile stations to this network, either in wired fashion with the aid of wiring or in wireless fashion with the aid of an IR-transmitter-receiver means, the above-mentioned problems concerning safety, range and frequency planning are solved while providing opportunities for convenient mobile communication just about anywhere.

The simplest way to connect a mobile station to the network on board is to provide wiring between the connecting means of the network and a connecting socket of an external aerial to a mobile station, in which case the connecting means of the network on board, say, an aeroplane may be provided at the armrest of a passenger seat and be in the form of a plug socket.

Alternatively, use can be made of IR-transmitter-receiver means, i.e. signal transmission by means of infrared light, in which case the IR-transmitter-receiver means comprise an IR-transmitter-receiver that either is connectible to a connecting means of an external aerial at a mobile station or is integrated into a special IR-mobile station, as well as an IR-transmitter-receiver that is connected to the network.

Preferably, a mobile station that is connectible to the network on board consists of an anonymous mobile terminal and a circuit means which is placed therein and can be identified with the aid of the switching means. Preferably, the circuit means is in the form of a microchip

which, to enable the use of different mobile terminals, such as a personal pocket phone mounted in the vicinity of a passenger seat or a pay phone, conveniently is embedded in a plastic card which may be of "credit-card" size or "stamp" size and which can easily be inserted into such a mobile terminal in order to open the terminal to outgoing calls, as well as to incoming calls at the unique telephone number linked to the microchip. By "call" is here meant not only ordinary telephone calls but also communication by means of a fax machine or a computer.

Preferably, the switching means forming part of the inventive system comprises at least one base station adapted to communicate with the mobile stations on board, a base station switching means controlling the base station, and a switching centre connecting calls to and from the mobile stations connected to the network on board and providing a basis for charging the services employed through the mobile stations.

Preferably, the network on board is constructed as a GSM network (Global System for Mobile Communications), and the transmitter-receiver means for the external signal transmission consists of a telecommunication system of TFTS type (Terrestrial Flight Telephony System) which is designed with aeroplane telecommunication in mind and thus does not disturb any other systems on board.

Preferably, the switching means has an interface by means of which the recorded information concerning the services employed may, suitably after landing, be transferred to a ground-based computer system, which also can be used for a ground-based mobile communications network that is compatible with the network on board, so that a subscriber to the ground-based network is able to use his mobile station also in the network on board and may have also the telecommunication services employed on board, say, an aeroplane included in his regular subscription invoice.

A preferred embodiment of the invention will be described in more detail below with reference to the accompanying drawings, in which

Fig. 1 schematically illustrates one construction of the system; and

Fig. 2 schematically illustrates a mobile terminal and a subscriber's card that can be inserted into it.

At the bottom of Fig. 1, an ordinary mobile communications network 1 is schematically illustrated. This network is of GSM type and comprises a switching centre MSC for controlling calls within the network 1, as well as incoming and outgoing calls. The users of the network 1 make their calls with the aid of mobile stations MS, which consist of a mobile terminal MT that may be in the form of a pocket phone, as appears from Fig. 2, as well as a subscriber's card SIM that can be inserted into the mobile terminal MT.

The subscriber's card SIM comprises a microchip 2 and thus is a so-called smart card enabling various data (e.g. country code, operator code and subscriber's number) to be reliably stored in the microchip 2. When inserted into an anonymous mobile terminal MT, the card SIM converts the terminal into a personal mobile station MS, which is open to outgoing calls and, in particular, to incoming calls at the subscriber's unique telephone number, which thus is linked to the card SIM only, and not to the mobile terminal into which the card is inserted. Also, the data stored in the card SIM make it possible for the network operator to link the telecommunication services employed through a mobile station MS to the right subscriber for charging purposes, regardless of whether he subscribes to the current network 1 or is but a visitor.

The mobile stations MS are in wireless communication with the GSM network 1 by means of radio waves, which are transmitted between an aerial 3 incorporated into the mobile terminal MT, or an external aerial (not shown)

connected to a socket 4 at the mobile terminal, and an aerial or base station BTS forming part of the network 1. An ordinary GSM network includes a fairly large number of base stations BTS which, either separately or in a certain number, are connected to base station switching means BSC. The latter control and monitor the base stations BTS, and are in turn connected to the switching centre MSC.

The GSM network 1 communicates with other telecommunications networks, such as the public telephone network PSTN or the mobile communications networks 5 of other operators, via the switching centre MSC, which can be connected to a computer system BASS which, on the basis of the charging material obtained from the switching centre MSC, sees to it that invoices 6 are printed out by means of printers 7.

At the top of Fig. 1, a mobile communication system 8 according to the invention is schematically illustrated. This system may be installed on board an aeroplane 9 or a ship 10. The system 8 includes a very small GSM network 11 which, unlike a ground-based GSM network 1, has a single base station BTS only. As is customary, the base station BTS on board is connected to a base station switching means BSC, which in turn is connected to a switching centre MSC. Like the switching centre of the ground-based network 1, the switching centre on board controls the calls within the network 11, as well as the calls between the network and surrounding world. Also, the switching centre records the users of the network 11 and provides a charging basis.

The GSM network 11 mainly differs from the ground-based network 1 in that the mobile stations MS on board, which are connected to the base station BTS on board, do not communicate with the base station BTS with the aid of wireless transmission of radio waves, but employs either wired transmission with the aid of wires or wireless

transmission with the aid of IR-transmitter-receiver means.

Wired transmission can be carried out by connecting the base station BTS on board to a loop having connecting means 12, which on board an aeroplane may be provided at the ceiling above a passenger seat or at the armrest of the chair, and by connecting the mobile stations MS on board to these means with the aid of wires 13 connected to the aerial sockets 4 at the mobile stations. In wireless transmission with the aid of IR-transmitter-receiver means, use can be made of an IR-transmitter-receiver connected to the connecting means 12 of the base station, as well as an IR-transmitter-receiver connected to the aerial socket 4 of each mobile station. Alternatively, the base station BTS may comprise the same arrangement, but the ordinary mobile terminals MT may be replaced with special IR apparatus, into which the subscriber's card SIM fits and which, for instance, may be supplied by the airline at issue.

The communication between the network 11 on board and the surrounding world, i.e. various ground-based networks, such as the public telephone network PSTN or other networks 1, 5 connected thereto, is achieved in wireless fashion by means of radio waves emitted on frequencies and at transmitter output powers that do not disturb any systems on board and have a much larger range than an ordinary mobile station MS. The currently preferred transmission system is termed TFTS and enables multichannel radio communication at distances of 400 km and more between ground-based aerials 14 and aerials 15 mounted on board aeroplanes. In the communication with ships, use is, of course, made of other systems, such as short-wave transmission or satellite communication, but these forms of communication may naturally be used for aeroplanes as well. As appears from Fig. 1, the TFTS unit on the ground is connected to the public telephone network PSTN, whereas the TFTS unit on board the aeroplane or the ship is

connected to the network 11 on board, thus enabling calls between a mobile station MS on board and, say, a mobile station MS in the ground-based network 1.

In order that the system 8 according to the invention should work in actual practice, it must be possible to identify the users of the system. This is simply achieved with the aid of the personal subscriber's card SIM, where all information needed for the identification is stored. In contradistinction to the ground-based GSM network 1, the charging basis provided by the switching centre MSC is not transferred directly to a computer system, which then invoices the subscribers, but to a ground-based computer system BASS via an interface which, for instance, may include an ordinary floppy disc 16 that is supplied to a floppy-disc station connected to the computer system BASS after landing. Then, the ground-based computer system BASS invoices the subscribers on the basis of the charging material supplied via the interface and may, if so desired, be used for a ground-based GSM network as well.

It goes without saying that the inventive embodiment described above and primarily directed to air traffic and a GSM network is not intended to restrict the scope of the invention. Thus, the invention may be applied to mobile communications networks of other types than GSM, and the TFTS transmission system may be replaced with any other suitable system for communication between the aircraft or ship and the surrounding world.

CLAIMS

1. A mobile communication system comprising a network (11) which has means for connecting mobile stations (MS), as well as a switching means (MSC, BSC, BTS) adapted to identify the mobile stations (MS) connected to the network (11), connect calls to and from the mobile stations (MS), and record the services employed through the mobile stations (MS), c h a r a c t e r i s e d in that it is installed on board an aircraft or a ship, that it comprises a transmitter-receiver means (TFTS) adapted for wireless, external signal transmission between the network (11) on board and the surrounding world, and that it comprises wiring (13) or IR-transmitter-receiver means for wired or wireless, internal signal transmission between the network (11) on board and the mobile stations (MS) on board connected thereto.

Claim 9

2. The system of claim 1, c h a r a c t e r i s e d in that the wiring (13) are connectible to a means (4) for connecting an external aerial to a mobile station (MS), as well as connectible to means (12) for connecting the network (11).

3. The system of claim 1, c h a r a c t e r i s e d in that the IR-transmitter-receiver means comprise an IR-transmitter-receiver that is connectible to a means (4) for connecting an external aerial to a mobile station (MS), as well as an IR-transmitter-receiver that is connected to the network (11).

4. The system of claim 1, c h a r a c t e r i s e d in that the IR-transmitter-receiver means comprise an IR-transmitter-receiver that is integrated into a special IR mobile station, as well as an IR-transmitter-receiver that is connected to the network (11).

5. The system of any one of claims 1-3, c h a r a c t e r i s e d in that the network (11) on board is compatible with a ground-based mobile communications net-

work (1), such that a subscriber to the ground-based network (1), or to another mobile communications network (5) of the same type, is able to use his mobile station (MS) in the network on board as well.

6. The system of any one of the preceding claims, c h a r a c t e r i s e d in that a mobile station (MS) connectible to the network (11) on board consists of a mobile terminal (MT) and a circuit means arranged therein and identifiable with the aid of the switching means (MSC).

7. The system of claim 6, c h a r a c t e r i s e d in that the circuit means consists of a microchip (2) embedded in a plastic card (SIM) that is insertable into different mobile telephones (MT) in order to activate these for incoming as well as outgoing calls.

8. The system of any one of the preceding claims, c h a r a c t e r i s e d in that the switching means comprises at least one base station (BTS) adapted to communicate with the mobile stations (MS) on board, a base station switching means (BSC) adapted to connect calls to and from the mobile stations (MS) connected to the network (11) on board and to provide a basis for charging the services employed through the mobile stations (MS).

9. The system of claims 7 and 8, c h a r a c t e r - i s e d in that the network (11) on board is of GSM type (Global System for Mobile Communications), and that the transmitter-receiver means for the external signal transmission is a telecommunication system of TFTS type (Terrestrial Flight Telephony System).

10. The system of any one of the preceding claims, c h a r a c t e r i s e d in that the switching means (MSC, BSC, BTS) has an interface (16) by means of which the recorded information concerning the services employed can be transferred to a ground-based computer system (BASS).

FIG.I

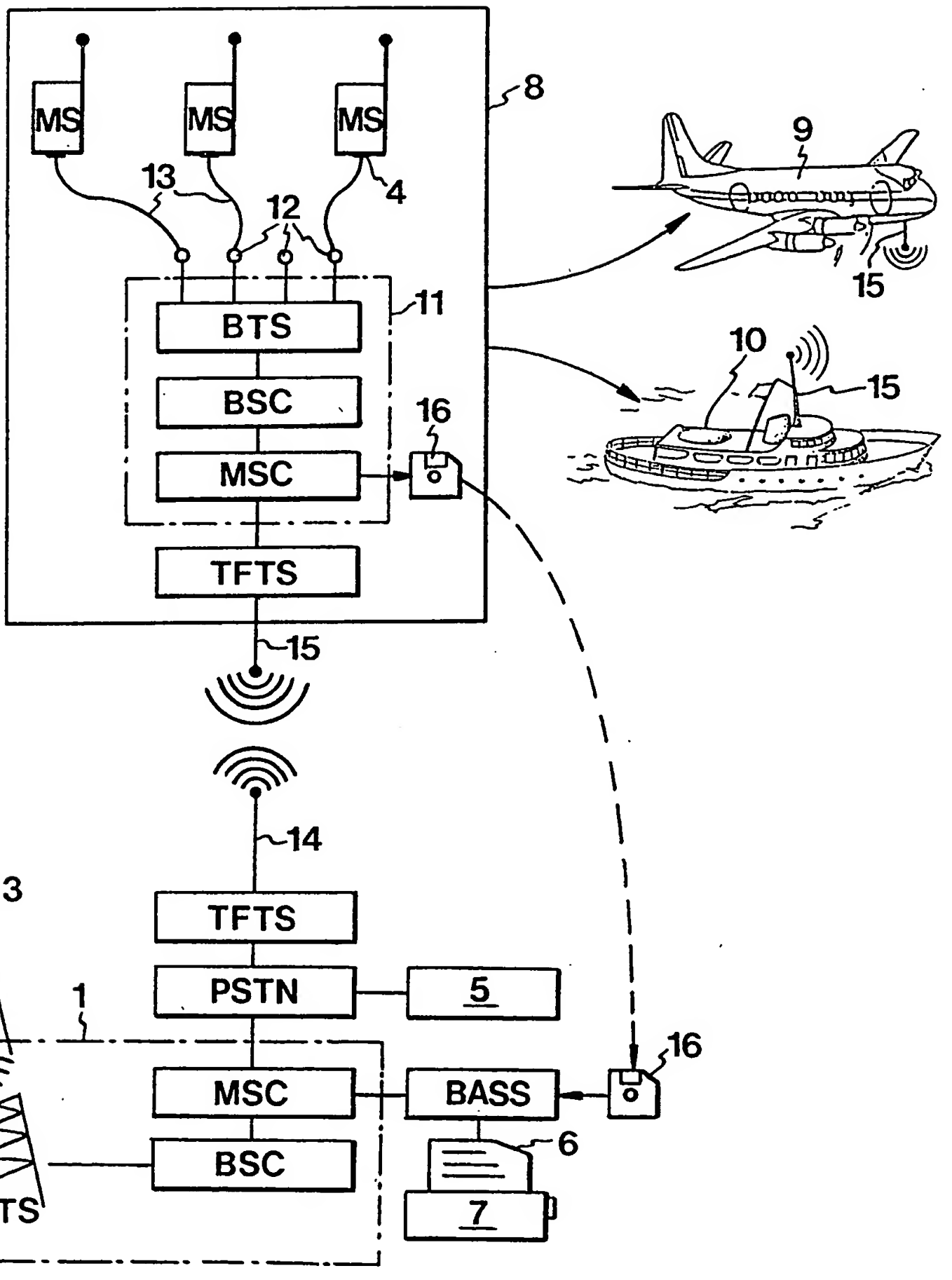
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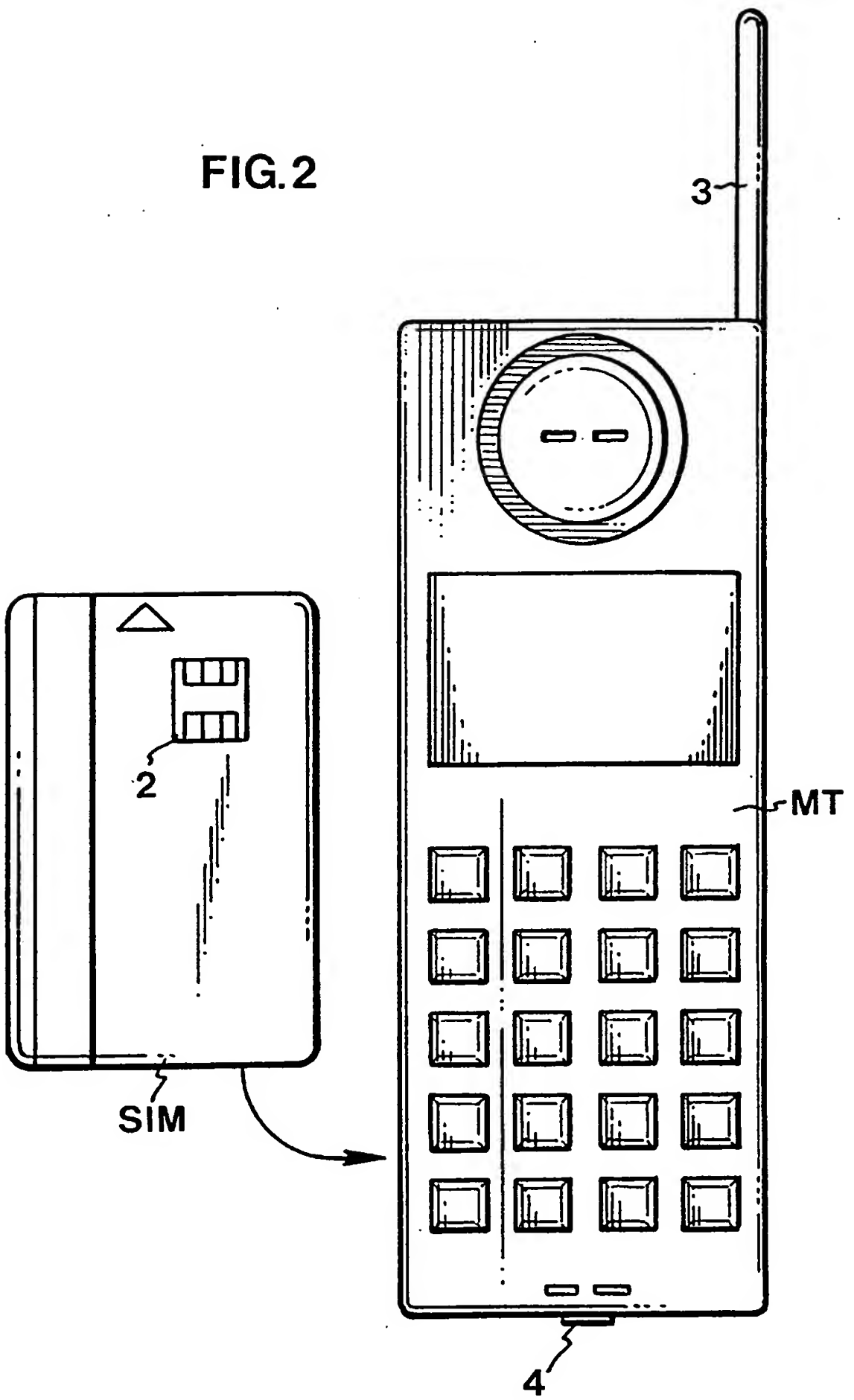
FIG.2



INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC5: H04Q 7/00, H04B 7/185, H04Q 7/26
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE, A1, 3621990 (MAN TECHNOLOGIE GMBH), 29 January 1987 (29.01.87), the whole document ---	1-10
A	Communication & Transmission, Volume 4, 1991, E. FERNANDEZ ET AL, "Le TFTS Alcatel air-sol" page 5 - page 16 ---	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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29 August 1994	02 -09- 1994
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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/07/94

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A1- 3621990	29/01/87	NONE	

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